PINUS OAXACANA, A NEW SPECIES FROM MEXICO

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In Oaxaca and adjacent states of Mexico is found a pine with very long, prominent projections of the apophyses of the cone scales. Though previously identified as a variety of *Pinus pseudostrobus* Lindl., this pine differs from *P. pseudostrobus* especially in the cones and in the chemical composition of the turpentine, and it is here published as a new species.[1]

Pinus oaxacana Mirov, sp. nov. *P. pseudostrobus* var. *apulcensis* Shaw pro parte, as to two specimens cited, not as to type, Pines of Mexico, p. 19, 1909. Non *P. apulcensis* Lindley, Edwards' Bot. Reg. 25, Misc. 63, 1839. *P. pseudostrobus* var. *oaxacana* Martínez as to description, not as to type, Las Pinaceas Mexicanas 1:195. 1945. Oaxaca pine. *Pinus* subgenus *Diploxylon* Koehne. Arbor 20–30 m. alta, ramulis vernis uninodalibus, glaucis; folia 5 in fasciculo, 20–33 cm. longa, serrulata, tenuissima, flexilia, pendula; stomata dorsalia pleurumque 5–7 seriebus et stomata ventralia 3–5 seriebus untrinque; hypodermis 2–4 seriebus cellularum, uniformis vel multiformis; ducti resinosi mediani, 2–4; endodermis cum septis exterioribus cellularum crassis; fasciculi vasculares 2, approximati; vaginae ca. 28–18 mm. longae, persistentes; strobili subterminales, 1–3, subsessiles, 10–14 cm. longi, clausi ca. 6 cm. lati, aperti ca. 9–11 cm. lati, ovoidei vel conici, acuti, leviter asymmetricales vel obliqui, ad maturationem aperientes, decidui super squamas infimas; apophyses ca. 12–20 mm. latae et ca. 8–12 mm. altae, rhomboideae, crassae, carinatae, cum projectione prominenti elongata 5–22 mm. longa, basi 5–12 mm. lata et 3–8 mm. crassa, pyramidali vel conica, dura, complanata, recta vel curvata et reflexa; umbo in parte exteriore projectionis in puncto brevi terminens; projectiones inaequales, ad latum abaxialem strobili longiores; semen 6–7 mm. longum, obovoideum, atro-brunneum, cum ala separabili brunnea ca. 20 mm. longa et 8–9 mm. lata.

Resina terebintha n-heptane, 21 per centum; dextro- et dextro, laevo-α-pinene, 51 per centum; laevo- et dextro, laevo-limonene, 15–16 per centum; n-undecane, 1.3 per centum; et sesquiterpene, longifolene, 7.5 per centum componitur.

Tree 20–30 m. tall, the spring shoots uninodal, glaucous; leaves 5 in a fascicle, 20–33 cm. long, serrulate, very slender, flexible, drooping; dorsal stomata mostly 5–7 rows and ventral stomata 3–5 rows on each side; hypodermis of 2–4 layers of cells, uniform or multiform; resin ducts medial, 2–4; endodermis with outer cell walls thick; vascular bundles 2, close together; sheaths about 28–18 mm. long, persistent; cones subterminal, 1–3, subsessile, 10–14 cm. long, ovoid or conic, acute, slightly asymmetrical or oblique, opening at maturity, deciduous above lowest scales; scales

[1] Dr. Elbert L. Little, Jr., of the United States Forest Service, assisted in preparing the Latin and English descriptions and in checking the nomenclature.

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with apophyses ca. 12–20 mm. broad and 8–12 mm. high, rhomboidal, thick, keeled, the apophyses with projections prominent, elongate, unequal (those on abaxial side of cone longer), 5–22 mm. long, 5–12 mm. wide at base, 3–8 mm. thick at base, pyramidal to conic, hard, flattened, straight or curved and reflexed, the umbo on outer part of each projection ending in a short point; seeds 6–7 mm. long, obovoid, dark brown, with detachable brown wing ca. 20 mm. long and 8–9 mm. wide.

The turpentine is composed of n-heptane, 21 percent; d, dl-α-pinene, 51 percent; l, dl-limonene, 15–16 percent; n-undecane, 1.3 percent; and a sesquiterpene, longifolene, 7.5 percent.[2] A herbarium specimen which serves as a voucher for the turpentined trees was collected near Rancho Nuevo, 65 kilometers southwest of San Cristobal de Las Casas, Chiapas, Mexico (Mirov, in 1951) and is deposited at the Institute of Forest Genetics, Placerville, California.

Holotype. Near La Parada, Oaxaca, Mexico, altitude 7,500–9,000 feet, August 18, 1894, *E. W. Nelson 985* (US 398558). A slightly reduced drawing of the cone of the holotype which is about 13 cm. long, was reproduced by Shaw (1909, pl. 12, fig. 8; 1914; pl. 24, fig. 214). Another cone illustrated by Shaw (1909) is: *E. W. Nelson 2539* (US 398583), Miahuatlán, Oaxaca.

Under the name *P. pseudostrobus* var. *oaxacana* Martínez, detailed descriptions and good illustrations of *P. oaxacana* were published by Martínez (1945, pp. 195–201; 1948, pp. 202–9) and by Loock (1951, pp. 161–164). In addition, both of these writers recorded it as occurring in the states of Oaxaca, Mexico, Puebla, Guerrero, Veracruz, and Chiapas.

In his treatment of the pines of Mexico, Shaw (1909) included this taxon as a variety of *P. pseudostrobus* Lindley (Edwards' Bot. Reg. 25, Misc. 63, 1839), basing his concept on Lindley's *P. apulcensis* (ibid.) and characterizing it as having "a greater or less prolongation of the apophyses." Shaw cited and illustrated three specimens: *E. W. Nelson 985,* La Parada, Oaxaca; *E. W. Nelson 2539,* Miahuatlán, Oaxaca; and *Pringle 8788,* Eslava, Distrito Federal. He assumed that all these specimens, as well as a cone collected by Hahn in 1866 at Cofre de Perote, Veracruz, and in the Museum d'Histoire Naturelle in Paris, were the same as *P. apulcensis* Lindl. from Apulco, Hidalgo.

Martínez (1945, pp. 168–201; 1948, pp. 184–209) recognized within *P. pseudostrobus* six variations (the typical variety, four named varieties and one form), differing chiefly in cone scale characters. Two of these named varieties and the form are pertinent herein. He showed clearly that the two Nelson Oaxaca collections, cited by Shaw as *P. pseudostrobus* var. *apulcensis,* belong to another taxon which he (Martínez) illustrated and described (in Spanish, loc. cit.) as *P. pseudostrobus* var. *oaxacana.* Unfortunately, Martínez failed to cite a type specimen, to publish a Latin

[2] This information was obtained from one sample, in which oleoresin from 25 trees was combined. In other samples the percentages may be different. Of significance is the presence of large quantities of a paraffin hydrocarbon, normal heptane.

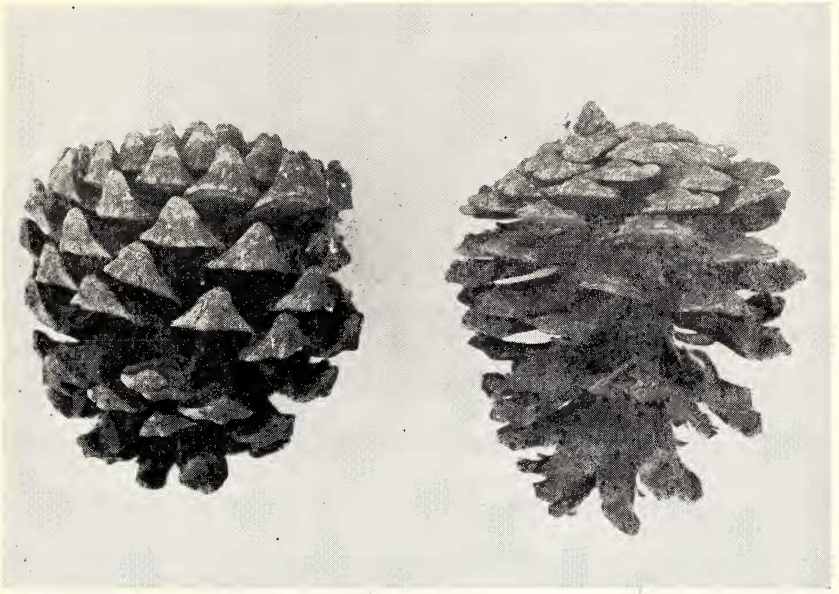

FIG. 1. Cone of *P. pseudostrobus* (left); cone of *P. oaxacana* (right). Both ca. × ⅓. Photo courtesy California Forest and Range Experiment Station, U. S. Forest Service.

diagnosis, or to designate the synonym *P. pseudostrobus* var. *apulcensis* (Lindl.) Shaw as applicable to his material only "in part." Therefore, although his intent was clearly otherwise, the name *P. pseudostrobus* var. *oaxacana* of Martínez must be referred to the type specimen (*Hartweg* in 1838, Apulco, Hidalgo) upon which both *P. apulcensis* Lindl. and *P. pseudostrobus* var. *apulcensis* (Lindl.) Shaw are based. Hence, it has been necessary to present a formal description and typification of the taxon represented by the Nelson Oaxaca specimens. To the pine from Apulco (*P. apulcensis* Lindley), Martínez (1945, p. 192; 1948, p. 199) assigned the name *P. pseudostrobus* var. *apulcensis,* an epithet which was superfluous when published, inasmuch as Shaw had already published this combination in 1909.

Under *P. pseudostrobus* var. *apulcensis,* Shaw cited a third collection with least prominent apophysis, *Pringle 8788* from Eslava, Distrito Federal. This collection had been distributed as *P. pseudostrobus* but had the synonym *P. protuberans* Roezl also on the printed label. *Pringle 8788* is therefore referred to *P. pseudostrobus* forma *protuberans* Martínez (1945, p. 184; 1948, p. 192), which was characterized by the protuberant apophysis ending in a sharp point and which was recorded from Eslava as well as other localities.

However, it becomes desirable to establish the identity of the century-old prior species *P. protuberans* Roezl (Cat. Grain. Conif. Mex. 27, 1857) from 9,000–10,000 feet altitude near Contreras, Distrito Federal. Bene-

dict Roezl (1824–85), a Czech plant collector and horticulturist, in 1857 and 1858 published names of nearly one hundred new species of *Pinus,* mostly from the vicinity of Mexico City, in two commercial catalogs of Mexican conifers. The original descriptions of Roezl's species were republished and translated by other authors, of which the following may be cited for *P. protuberans*: German, condensed, by Otto (Hamburg. Gart. Blumenzeit. 13:408. 1857); English by Gordon and Glendinning (Pinetum 259. 1858); Latin by Schlechtendal (Linnaea 29:348. 1858); and the original French by Carrière (Traité Gén. Conif. Ed. 2, 522. 1867).

Actually, Roezl characterized the five members of his Section VIII of *Pinus* as having five long needles and very prominent apophyses and protuberances, characters which indicate close relationship with the *P. pseudostrobus* complex and with *P. oaxacana*. Besides *P. protuberans,* this section had three other new species, *P. angulata* Roezl, *P. exserta* Roezl, and *P. heteromorpha* Roezl, and also *P. rudis* Endl. (a misapplication of that name).

Gordon (Sup. Gord. Pinetum 70, 1862; Pinetum Ed. 2, 319, 1875) examined Roezl's specimens and accepted *P. protuberans* Roezl, giving the other species of Roezl's Sect. VIII as synonyms under *P. protuberans*. Carrière (*ibid.*) also accepted *P. protuberans* Roezl, quoted the original description, and published a longer description of Roezl's dry specimens and living young plants. He reduced two species to varieties [*P. protuberans angulata* and *P. protuberans exserta*], and retained *P. heteromorpha* Roezl as a species. Parlatore [in DC., Prodr. 16(2):401–402. 1868] reduced *P. protuberans* and *P. heteromorpha* to synonymy under *P. pseudostrobus* Lindl. and placed *P. angulata* and *P. exserta* under *P. montezumae* Lamb. In a summary of 82 new species of *Pinus* in Roezl's catalog of 1857, Shaw (1909, p. 3 and table) cited the above and other references, noted that many of Roezl's specimens had been lost, and concluded that there was not a single valid species among the six or seven pines represented.

The epithets *P. protuberans* Roezl and *P. pseudostrobus* forma *protuberans* apparently refer to the same entity. The cone scale of *P. protuberans* has a protuberance, while that of *P. oaxacana* has a longer, more prominent projection. Therefore, because of the morphological and geographical differences, this pine from Oaxaca is not referable to any of Roezl's species.

Pinus oaxacana differs from typical *P. pseudostrobus* by the prominent projections of the apophyses of the cone scales. In the general part of his Los Pinos Mexicanos (Martínez, 1948, p. 37), Martínez showed drawings of the cone scales of his variety *oaxacana* and of *P. coulteri* D. Don as examples of protuberant apophyses.

When I collected oleoresin of Oaxaca pine in 1951 in Chiapas, Mexico, I found typical *P. pseudostrobus* and *P. oaxacana* growing together and I was much impressed by the difference in the cones. The heavy cones of Oaxaca pine resembled the cones of Shaw's group *Macrocarpae* (1914) more than the cones of typical *P. pseudostrobus*.

Shaw's group *Macrocarpae* consists of *Pinus torreyana* Parry, *P. coulteri* D. Don and *P. sabiniana* Dougl. In my opinion *P. jeffreyi* Murr. also is closely related to this group since, among other considerations, it crosses naturally with *P. coulteri*. Besides the morphological and genetic affinities of these pines, they all have common biochemical characters. Their turpentines all contain aliphatic hydrocarbons, either normal heptane C_7H_{16} or normal undecane $C_{11}H_{24}$ or both (Table 1).

Turpentine of *Pinus pseudostrobus* was analyzed by Iriarte (1946), and was found to contain over 90 percent of d-α-pinene and a small quantity of an unidentified sesquiterpene. Turpentine of *P. oaxacana* has an entirely different composition. It contains: n-heptane, 21 percent; d, dl-α-pinene, 51 percent; l, dl-limonene, 15–16 percent; n-undecane, 1.3 percent; and a sesquiterpene, longifolene, 7.5 percent (Iloff and Mirov, 1953). Chemically *P. oaxacana* has much more in common with the pines of the group *Macrocarpae,* including *P. jeffreyi,* than with *P. pseudostrobus* (Table 1).

Table 1. Occurrence of Some Chemical Substances in the Turpentines of Several Pines

	n-heptane	α-pinene	limonene	n-undecane	longifolene	aldehydes	β-phellandrene
P. jeffreyi	+	....	....	....	....	+	....
P. sabiniana	+	....	....	....	....	+	....
P. coulteri	+	+	....	+	....	+	+
P. torreyana	+	....	+	+	+	+	....
P. oaxacana	+	+	+	+	+	....	....
P. pseudostrobus	....	+	....	....	?	....	....

The proposal to elevate Oaxaca pine to a specific rank is based on consideration of both morphological and biochemical characteristics of the pine. The use of biochemical characters for taxonomic purposes is gaining more and more ground among taxonomists, especially in view of the brilliant research on Australian trees by Penfold (1935) and his co-workers. Among the pines, *Pinus jeffreyi* is an outstanding example of the validity of biochemical characters in taxonomy. This pine has been considered by some botanists for a long time as a variety of *P. ponderosa* (Shaw, 1914). Lately, however (and at least, partly because of profound chemical differences of the two pines) *P. jeffreyi* has been reinstated to its original status as a valid species.

Pinus oaxacana apparently crosses naturally with *P. pseudostrobus*. It is entirely possible that great variability in the structure of the cone scales within the *P. pseudostrobus* complex has been caused by hybridization

between these two pines. *Pinus oaxacana* also probably crosses with some varieties of *P. montezumae,* but consideration of such behavior is beyond the scope of this paper.

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CHROMOSOME COUNTS IN SECTION ERYTHRANTHE OF THE GENUS MIMULUS (SCROPHULARIACEAE)[1]

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Brozek (1932) of Charles University, Prague, has determined the chromosome numbers of three horticultural plants of *Mimulus cardinalis* to be $2n = 16$. These counts were made in connection with his investigation of the genetics of flower color in this species. The senior author also has carried on work on the inheritance of flower color in the *M. cardinalis* complex (Vickery and Olson, 1956). In addition he is undertaking a biosystematic study of the group. These investigations have necessitated a survey of the chromosome numbers of both the horticultural populations and the cultures of the wild races being used in these two studies. Herbarium specimens of all the cultures counted are deposited in the Garrett Herbarium of the University of Utah under the culture numbers given in Table 1.

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